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**Notes:**

1. Untranslatable words are replaced with asterisks (\*).
2. Texts in the figures are not translated and shown as is.

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**FULL CONTENTS**

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**[Claim(s)]**

[Claim 1] The dielectric constant which was made to contain colorant and was formed into the carrier liquid is the ink record method of making five or more ink breathing out from the tip opening of a nozzle, and making it adhering on a recording medium or a middle recording medium, and as a (i) this nozzle While impressing voltage to the bias electrode arranged in the wall surface of using for the wall surface the nozzle which arranged the bias electrode and the picture electrode, arranging an opposite electrode ahead of the tip opening of (ii) this nozzle, and this (iii) nozzle With the voltage impressed to this bias electrode, the voltage of an opposite phase is impressed to the opposite electrode arranged ahead of the tip opening of this nozzle, (iv) Make a recording medium or a middle recording medium exist between the tip of this nozzle, and this opposite electrode, (v) The ink record method characterized by impressing the voltage impressed to this bias electrode according to a picture signal, and the voltage of this phase to the picture electrode arranged in the wall surface of this nozzle, and making it breathe out this ink from the tip opening of this nozzle.

[Claim 2] The ink record method according to claim 1 that the carrier liquid of this ink is the mixed-solution of water or water, and a water-soluble organicity liquid.

[Claim 3] The ink record method according to claim 1 or 2 that colorant of this ink is dye or paints.

[Claim 4] The ink record method according to claim 1 to 3 that this ink contains a nonionic surface-active agent.

[Claim 5] The dielectric constant which was made to contain colorant and was formed into the carrier liquid is the ink recording head mechanism in which five or more ink is made to adhere on a recording medium or a middle recording medium. (i) The ink recording head mechanism characterized by having the opposite electrode arranged ahead of the tip opening of a nozzle and (ii) this nozzle which makes a wall surface breathe out the ink which arranged the bias

electrode and the picture electrode from the tip opening.

[Claim 6] The dielectric constant which was made to contain colorant and was formed into the carrier liquid is the ink recording equipment which has the ink recording head mechanism in which five or more ink is made to adhere on a recording medium or a middle recording medium. Ink recording equipment characterized by using an ink recording head according to claim 5 as this ink recording head mechanism.

[Claim 7] The dielectric constant which was ink used for the ink record method of Claim 1, was made to contain colorant and was formed into the carrier liquid is five or more ink.

[Claim 8] Ink according to claim 7 this whose carrier liquid is the mixed-solution of water or water, and a water-soluble organicity liquid.

[Claim 9] Ink according to claim 7 or 8 this whose colorant is dye or paints.

[Claim 10] Ink containing a nonionic surface-active agent according to claim 7 to 9.

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#### [Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the ink record method, an ink recording head mechanism, ink recording equipment, and ink including the process which makes \*\*\*\* act on ink.

[0002]

[Description of the Prior Art] The method of making \*\*\*\* act on this developing solution, moving this developing solution using the developing solution which distributed toner, into carrier liquids, such as silicon oil, making it breathe out from the opening formed at the substrate, and making the picture by that developing solution record on recording media, such as paper, is known (JP,2000-37898,A). [ include / the process which passes the opening formed in that center of a ring-like picture electrode in the developing solution in the case of this method ] It was not what in the top where it is difficult to raise resolution contains problems, like it is difficult to raise the movement speed, and there is when equipment cost becomes high, impresses \*\*\*\* further and moves a developing solution, and may still be satisfied.

[0003]

[Problem to be solved by the invention] In the ink record method of this invention making \*\*\*\* acting on this ink, moving this ink using the ink which distributed colorant into a carrier liquid, making it breathing out from an opening, and making an ink picture forming in a recording medium or a middle recording medium It is easy to raise the movement speed when making \*\*\*\* act on this ink and moving ink. It is easy to raise the resolution of the picture formed in this recording medium or a middle recording medium. Furthermore, equipment cost makes it the

technical problem to offer the ink used for the ink recording equipment and this ink record method of having the inexpensive ink record method, the ink recording head mechanism in which it uses for it, and this ink recording head mechanism.

[0004]

[Means for solving problem] This invention persons came to complete this invention, as a result of repeating research wholeheartedly that said technical problem should be solved. That is, according to this invention, the ink record method, the ink recording head mechanism, ink recording equipment, and ink which are shown below are offered.

(1) The dielectric constant which was made to contain colorant and was formed into the carrier liquid is the ink record method of making five or more ink breathing out from the tip opening of a nozzle, and making it adhering on a recording medium or a middle recording medium, and as a (i) this nozzle While impressing voltage to the bias electrode arranged in the wall surface of using for the wall surface the nozzle which arranged the bias electrode and the picture electrode, arranging an opposite electrode ahead of the tip opening of (ii) this nozzle, and this (iii) nozzle With the voltage impressed to this bias electrode, the voltage of the direction of an opposite phase is impressed to the opposite electrode arranged ahead of the tip opening of this nozzle, (iv) Make a recording medium or a middle recording medium exist between the tip of this nozzle, and this opposite electrode, (v) The ink record method characterized by impressing the voltage impressed to this bias electrode according to a picture signal, and the voltage of this phase to the picture electrode arranged in the wall surface of this nozzle, and making it breathe out this ink from the tip opening of this nozzle.

(2) The ink record method given in the above (1) whose carrier liquid of this ink is the mixed-solution of water or water, and a water-soluble organicity liquid.

(3) The above (1) whose colorant of this ink is dye or paints, or the ink record method given in (2).

(4) The ink record method given in either of aforementioned (1) - (3) in which this ink contains a nonionic surface-active agent.

(5) The dielectric constant which was made to contain colorant and was formed into the carrier liquid is the ink recording head mechanism in which five or more ink is made to adhere on a recording medium or a middle recording medium. (i) The ink recording head mechanism characterized by having the opposite electrode arranged ahead of the tip opening of a nozzle and (ii) this nozzle which makes a wall surface breathe out the ink which arranged the bias electrode and the picture electrode from the tip opening.

(6) The dielectric constant which was made to contain colorant and was formed into the carrier liquid is the ink recording equipment which has the ink recording head mechanism in which five or more ink is made to adhere on a recording medium or a middle recording medium. Ink recording equipment characterized by using the ink recording head of a description for the

above (5) as this ink recording head mechanism.

(7) The dielectric constant which was ink used for the ink record method of the above (1), was made to contain colorant and was formed into the carrier liquid is five or more ink.

(8) Ink given in the above (7) this whose carrier liquid is the mixed-solution of water or water, and a water-soluble organicity liquid.

(9) The above (7) this whose colorant is dye or paints, or ink given in (8).

(10) Ink given in either of aforementioned (7) - (9) containing a nonionic surface-active agent. [0005]

[Mode for carrying out the invention] The ink recording head mechanism of this invention consists of a nozzle which arranged the bias electrode and the picture electrode in the wall surface of a nozzle, and an opposite electrode arranged ahead of the tip of an opening of this nozzle. In said nozzle, the cross-sectional form of the ink passage can be arbitrary, and can be circle form, the shape of a polygon besides the ability to be circular (the shape of 4 square shapes, the shape of 6 square shapes, etc.), etc. 25-40000 micrometers<sup>2</sup> of cross-section areas of the ink passage are 100-10000 micrometers<sup>2</sup> preferably. Moreover, the form of the tip opening of this nozzle can be circle form, circular, the shape of a polygon, etc. The tip opening size is the cross-section area, it is 10000 micrometers<sup>2</sup> or less preferably, and 40000 micrometers<sup>2</sup> or less of the lower limit is usually about 100 micrometers<sup>2</sup>. When the opening is circular, 5-120 micrometers of the diameter is about 10-100 micrometers preferably. The high picture of resolution is given, so that the opening size is small.

[0006] Said nozzle has a bias electrode and a picture electrode on the wall surface. The arrangement position in particular of those electrodes was not restrained, but should just be independent mutually. For example, a picture electrode can be located in the upper part of the ink passage in a nozzle, a flank, or the following. Moreover, a picture electrode and the bias electrode can be plural.

[0007] an electrode is formed in said nozzle -- the -- an inner wall surface at least is formed with an electric insulator material. A plastic, glass, Ceramics Sub-Division, etc. are used as such a material. The case of the nozzle which consists of metal material, such as stainless steel and iron, among those a wall surface are coated with a plastic, for example, a fluoro-resin, silicone resine, etc.

[0008] The explanatory view about one mode of the ink recording head mechanism of this invention is shown. In drawing 1, 10 shows a nozzle, 1 and 2 show a nozzle wall, and 9 is the ink passage formed of the walls 1 and 2. 4 is a sealing agent which closes the nozzle back end opening. 3 is an ink feed pipe and is connected with the back end part of a nozzle 10. 8 shows the ink passage of the feed pipe. 6 shows a bias electrode and 7 shows a picture electrode. Arrangement of the electrodes 6 and 7 formed in the undersurface and the upper surface of the closure member 4 is not needed that these electrodes 6 and 7 should just be formed in the

wall which faced the ink passage 9 at least. Moreover, the tip (in drawing 1 , it is a left end) of the electrodes 6 and 7 does not need to exist to the tip of a passage 9. The cross-sectional form of the ink passage 9 of a nozzle 10 can be a round shape, circular, the shape of a polygon, etc. The sectional view of a nozzle which has a cross-sectional circle-shaped ink passage in drawing 2 is shown, and the sectional view of a cross-sectional 4 square-shape-like nozzle is shown in drawing 3 . The mark shown in these figures has the same meaning as the mark shown in drawing 1 .

[0009] accepting necessity in the surface of the bias electrode 6 and the picture electrode 7 -- a plastic film -- it can cover with the film of a fluoro-resin or silicone resin preferably. By formation of such a film, passage of the ink at the time of ink passing through a passage 9 becomes smooth.

[0010] In drawing 1 , 11 shows an opposite electrode. 12 shows 13 and a guidance roller and 14 show a pair of rollers (sending roller). 15 shows a belt-like middle recording medium and 16 shows a recording medium. The opposite electrode 11 is arranged ahead of the tip opening of a nozzle 10. The distance between the surface of the opposite electrode 11 and the tip of a nozzle 10 is usually 0.2-1.0mm preferably 0.1-2.0mm. That by which the opposite electrode 11 formed the metal film in the surface of a metal plate and electric insulating plates (a plastic, ceramics, etc.) is used. The quality of the materials of the belt-like middle recording medium 15 can be a plastic, metal, etc. that ink should just be the material which adheres in primary. The recording media 16 are paper, the plastic film with which the surface was formed in the ink absorption side, etc.

[0011] Recording using the ink recording head (printhead) mechanism shown in drawing 1 (image formation) supplies ink from a connecting tubule 3, and it makes the ink passage 9 in a nozzle full of ink through the passage 8. Next, voltage is impressed to the bias electrode 6 and the opposite electrode 11. In this case, to the bias electrode 6, the voltage of a plus phase is impressed and the voltage of a reverse phase, for example, the voltage of the phase of minus, is impressed to the opposite electrode 11 with the phase of the voltage made to impress to that bias electrode 6, for example. The voltage impressed to these bias electrodes 6 and opposite electrodes 11 is voltage of the range which the discharge of ink does not produce from the tip opening of a nozzle 10. In order to form a picture on the middle recording medium 15, based on a picture signal, voltage is impressed to the picture electrode 7. The voltage in this case is the voltage of the same phase as the voltage impressed to the bias electrode 6, for example, the voltage of a plus phase, and is the voltage of the strength which makes \*\*\*\* L breathe out from the tip opening of the passage 9 of a nozzle. The ink state breathed out from the tip opening of a nozzle changes by the strength of the voltage made to impress to the picture electrode 7, can be made to be able to project from the nozzle orifice, or can be made to inject by controlling the voltage.

[0012] The ink picture formed in the surface of the belt-like middle recording medium 15 is transferred by the surface of the recording media 16, such as paper, in rollers 13 and 14, and, thereby, the medium 17 which has a record picture is obtained. In addition, when replacing with said middle recording medium 15 and using the recording media 16, such as paper, a direct record picture can be formed on the recording medium.

[0013] By impressing voltage as mentioned above to said bias electrode 6, the opposite electrode 11, and the picture electrode 7, when the principle by which ink is breathed out from the tip opening of the nozzle is shown, it is as follows. If voltage is impressed to the bias electrode 6 in the state where ink is full in the ink passage 9 of a nozzle 10, since the dielectric constants are five or more dielectrics, in the ink, an electric charge will produce the ink by charge polarization. The other electricity power (dielectric migration power) commits the ink which produced the electric charge to the opposite electrode 11 to which voltage was impressed. [ in this case, the voltage impressed to the bias electrode 6 ] For example, it is 50-300v of pluses preferably, and the voltage of the voltage impressed to the bias electrode and 20-500v of voltage from which a phase differs, for example, minus, impressed to the opposite electrode 11 is [ 20-500v of pluses ] 50-300v of minus preferably. The voltage impressed to the bias electrode 6 and the opposite electrode 11 is the voltage of the range by which the ink in the nozzle passage 9 is not breathed out from the tip opening of the nozzle. What is necessary is just to decide the proper voltage suitably by preliminary experiment, since the concrete voltage changes with states of the dielectric constant and viscosity of ink, and the inner wall surface of a passage 9 etc. In the state where voltage was impressed to said bias electrode 6 and the opposite voltage 11 as mentioned above If the voltage of the same phase as the bias electrode 6 is impressed to the picture electrode 7, the \*\*\*\* density added to ink will increase, dielectric migration power stronger against the ink will be added, and, as a result, the discharge of the ink from the tip opening of a nozzle will arise. The voltage of 10-300v of pluses impressed to the picture electrode 7 is 20-200v of pluses preferably, for example.

[0014] In the above explanation, although the image formation principle by this invention was shown using the single nozzle which forms one pixel, an actual recording head consists of an aggregate of many nozzles. The example of those nozzle aggregates is shown in drawing 4 and drawing 5 . In drawing 4 , 21 shows the tip opening (circle form) of a nozzle, and 22 shows the adhesive agents (resin etc.) which adhere the nozzle aggregate of those large number. In drawing 5 , 21 shows the tip opening (the shape of 4 square shapes) of a nozzle, and 23 and 24 show a bridgewall. As for the opposite electrode 11, it is desirable to use as one common electrode to such a nozzle aggregate.

[0015] Into a carrier liquid, colorant is made to contain in the state of a dissolution state or distribution, and the ink of this invention forms it. In this ink, the dielectric constant of that ink is 30 or more more preferably 20 or more five or more, and although that upper limit in particular

is not restrained, it is usually about 70. The carrier liquid of ink should just give said dielectric constant to ink. In a carrier liquid, the dielectric constant is 40 or more preferably 30 or more five or more, and although the upper limit in particular is not restrained, it is usually about 80.

[0016] In the ink of this invention, 2S or less of the rate [ 1S or less of ] of electrical conduction is 0.5S or less more preferably. The lower limit is usually 0.001S. If the rate of electrical conduction of ink exceeds 2S, when voltage is impressed, it will become easy to produce leak and will produce un-arranging of being damaged in an electrode.

[0017] The mixed-solution of water, an organic solvent, and a water and an organic solvent is included by the carrier liquid used by this invention. A polar organic solvent is included by the organic solvent. As for \*\*\*\* of an organic solvent, it is preferably desirable that it is 60 degrees C or more, and is 300 degrees C or less 50 degrees C or more. the organic solvent (ethanol --) which has a hydroxyl group as such an organic solvent Iso propanol, butyl alcohol, ethylene glycol, polyethylene glycols, , such as propylene glycol, -- the organic solvent (methyl ethyl ketone --) which has a carbonyl group Diethyl ketone etc.; JIMECHIRUHORUMU acid besides [ which has the organic solvent (propylamine, butylamine, etc.); carboxyl group which has an amino group ] organic solvents (acetic acid, propionic acid, etc.), JIOKISAN, dimethyl sulfoxide, etc. are mentioned.

[0018] Dye and paints are included by said colorant. As dye, what [ various kinds of ] that is dissolved in said carrier liquid is conventionally well-known is used. What [ various kinds of ] that is distributed as paints without dissolving in said carrier liquid is conventionally well-known is used. Generally it can be toner used for the development agent for electronic photographs. When the example of dye is shown, for example C. I Direct Yellow11, 12, 27, 28, 33, 39, 44 and 50, 58 grade;C.I Direct Red 2, 4, 9, 11, 20, and 23, 24 grade;C.I Direct Blue 1, 15, 22, 25, 41, and 76, and 77 grades are mentioned. If the example of paints is shown, insoluble azo pigment, a chelate azo pigment, a phthalocyanine pigment, PERIREN paints, anthraquinone paints, a quinacridone pigment, etc. will be mentioned. the colorant concentration in ink -- 1 per carrier liquid 100 weight part - 50 weight part -- it is the rate of 2 - 30 weight part preferably.

[0019] the inside of ink -- a surface-active agent -- a nonionic surface-active agent can be made to contain preferably Various kinds of nonionic surface-active agents currently used widely as such a nonionic surface-active agent, For example, polyoxyethylene alkyl ether, sucrose fatty acid ester, Sorbitan fatty acid ester, glycerine fatty acid ester, polyglyceryl fatty acid ester, Polyoxyethylene sorbitan fatty acid ester, polyoxy ethylene sorbitol fatty acid ester, Polyoxyethylene glycerine fatty acid ester, polyoxy ethylene glucol fatty acid ester, Polyoxyethylene-alkyl-ether phosphorus acid and its salt, polyoxyethylene-alkyl-ether sulfate, Polyoxy ethylene FITO sterol and phytostanol, polyoxyethylene-alkyl-phenyl-ether phosphorus acid, and its salt, Polyoxy ethylene lanolin and lanolin alcohol, polyoxyethylene alkylamine and

fatty acid amide, polyoxyethylene polyoxypropylene alkyl ether, polyoxyethylene alkyl phenyl ether, fatty acid ethanol amide, etc. are mentioned.

[0020] In the ink of this invention, the viscosity of 25 degrees C of below 600 sentimental POIZU is below 500 sentimental POIZU preferably. The lower limit is usually 30 sentimental POIZU grade. Since the movement speed becomes slow, the ink with big viscosity is not desirable to high-speed printing. The ink of this invention can be electrification ink. When \*\*\*\* is added to electrification ink, the electrostatic power proportional to the \*\*\*\* arises, and the electrostatic power also comes to act on the ink with said dielectric migration power. For this reason, the movement speed of ink is raised and high-speed printing of it is attained. Control of the amount of electrifications in ink can be performed by making a general water-soluble electrification control agent contain in ink.

[0021] The ink recording equipment (image formation equipment) of this invention has said recording head mechanism, and shows drawing 6 the one example. Drawing 6 shows the basic composition figure of the ink recording equipment of this invention. Y shows a yellow ink recording head among a figure, M shows a magenta ink recording head, and, as for C, a SHIANIN ink recording head and Bk show a black ink recording head. 31, 33, 35, and 37 show the nozzle aggregate connected with each ink recording head Y, M, C, and Bk, and 32, 34, 36, and 38 show the opposite electrode countered and arranged at the tip of these nozzle aggregate. In the equipment shown in drawing 6, it is sent to Y, M, C, and Bk which were taken out from the controller, printing of four colors is performed to a transfer object (middle recording medium), and, thereby, a full color ink picture is formed in a transfer object. This ink picture is transferred on the recording medium (paper) 41 on the transfer roll 42, and the recording medium 43 which has a picture is obtained.

[0022]

[Working example] Next, this invention is further explained in full detail according to a work example.

[0023] To the work-example 1 pure-water 100 weight part, the dye (C. I Direct Yellow 8) 20 weight part was dissolved, the polyethylene-glycols (molecular weight: 500,000) 5 weight part was mixed to this, uniform solution was produced ultrasonically, and Ink A was obtained. The dielectric constant of this ink A was 60.3, that viscosity of 25 degrees C was 100 sentimental POIZU, and that electrical conductivity was 0.002S.

[0024] In the mixed-solution (a mixed bulk density = 80/20) of work-example 2 water and methanol, azo pigment with an average particle diameter of 0.3 micrometer was distributed at concentration 25wt%, and Ink II was obtained. The dielectric constant of this ink II was 67.7. Moreover, the viscosity of 25 degrees C was 50 sentimental POIZU, and the electrical conductivity was 0.003S.

[0025] It recorded by applying the ink II shown in the work-example 3 work example 2 to the



recording head mechanism shown in drawing 1 . The record conditions in this case are as follows.

Bias electrode 6 impressed electromotive force : (1) +300V (2) opposite electrode 11 impressed-electromotive-force: -300V(3) nozzle 10 tip opening (square) area: -- distance [ of the surface of the 10000 micrometer2(4) opposite electrode 11, and the tip opening of a nozzle 10]: -- [ make 0.3mm of papers exist between the opposite electrode 11 and the tip opening of a nozzle on said conditions, and ] When the voltage of +100v was impressed to the picture electrode 7, ink breathed out from the tip opening of the nozzle 10, and it was checked that a picture is formed on the surface of paper. Moreover, time after impressing voltage to the picture electrode 7 in this case until ink is breathed out from the tip opening of a nozzle was 1 m seconds.

[0026] In work-example 4 work example 3, it experimented similarly except having used the ink I shown in the work example 1 instead of Ink II. Also in this case, ink was breathed out from the tip opening of the nozzle and it was checked that a picture is formed on the surface of paper.

[0027]

[Effect of the Invention] According to this invention, high-speed printing can be performed on a recording medium using simple and inexpensive equipment.

[Brief Description of the Drawings]

[Drawing 1] The explanatory view about one mode of the ink recording head mechanism of this invention is shown.

[Drawing 2] The sectional view of a nozzle which has the ink connection of cross-sectional circle form used by this invention is shown.

[Drawing 3] The sectional view of the cross-sectional 4 square-shape-like nozzle used by this invention is shown.

[Drawing 4] The explanatory view of the tip opening (circle form) side of a nozzle aggregate is shown.

[Drawing 5] The explanatory view of the tip opening (shape of 4 square shapes) side of a nozzle aggregate is shown.

[Drawing 6] The basic composition figure of the ink recording equipment of this invention is shown.

[Explanations of letters or numerals]

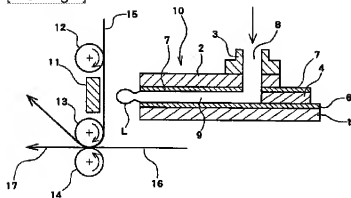
1, 2 Nozzle wall

3 Ink Feed Pipe

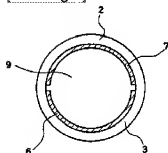
6 Bias Electrode  
7 Picture Electrode  
9 Ink Passage  
10 Nozzle  
11 Opposite Electrode  
15 Middle Recording Medium  
16 Recording Medium  
21 Tip Opening of Nozzle  
22 Adhesive Agent  
23, 24 Bridgewall  
31, 33, 35, 37 Nozzle aggregate  
32, 34, 36, 38 Opposite electrode

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[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]